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Association of depressive symptoms with health care utilization in older adults: Longitudinal evidence from the Survey of Health, Aging and Retirement in Europe

Running head: Depressive symptoms and health care utilization

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ABSTRACT

Objectives: Many older adults with depression do not receive adequate treatment. Differences in treatment utilization may reflect the heterogeneous nature of depression, encompassing multiple distinct symptoms. We assessed whether depressive symptoms are differentially associated with subsequent health care utilization with respect to three outcomes: 1) contact with a medical doctor (MD), 2) depression-specific treatment and 3) inpatient psychiatric admission.

Methods/Design: Longitudinal analyses were based on data from three follow-up cycles conducted between 2004 and 2013 among 53,139 participants from the Survey of Health, Aging and Retirement in Europe. Depressive symptoms were self-reported at baseline of each follow-up cycle using the 12-item EURO-D scale. Health care utilization was self-reported at the end of each follow-up cycle.

Results: After adjustment for sex, age, country of interview, follow-up time, educational attainment, presence of a partner in household, body-mass index, the number of chronic diseases, disability and average/prior frequency of contact with an MD, people with more frequent contact with an MD had most often reported sleep problems (IRR=1.10) and fatigue (IRR=1.10), followed by sad/depressed mood, tearfulness, concentration problems, guilt, irritability and changes in appetite. Those treated for depression had most often reported sad/depressed mood (OR=2.18) and suicidal ideation (OR=1.72), but also sleep problems, changes in appetite, fatigue, concentration problems, hopelessness and irritability. Sad/depressed mood (OR=2.87) was also associated with psychiatric inpatient admission. Similarly to other outcomes, appetite change, fatigue and sleep problems were associated with inpatient admission.

Conclusions: Specific symptoms of depression may determine utilization of different types of health care among elderly.

Keywords: depression; health services; epidemiology; international; mood disorders

Key points:

- We examined whether specific depressive symptoms are differentially related to health care utilization.
- Those with frequent contact with a medical doctor most often reported prior fatigue and sleep problems, whereas those receiving depression-specific treatment most typically reported prior sad/depressed mood and suicidal ideation. Sad/depressed mood was the most important predictor of psychiatric inpatient admission.
- Symptom-level differences in treatment-seeking behavior may be helpful in understanding mental health care associated with depression among elderly individuals with different symptom profiles.

INTRODUCTION

Depressive symptoms tend to increase when people transition from middle adulthood to older age, often together with worsening physical health.[1–3] Depressive symptoms among the elderly are frequently comorbid with chronic diseases, disability and dementia, which may complicate differential diagnosis and treatment options.[3,4] Despite the adverse psychosocial effects of even mild depressive symptoms in older adults,[1,2] most people suffering from depressive symptoms do not receive adequate treatment.[2,3,5]

Several factors can contribute to why some individuals are more or less likely to be treated.[6,7] This may partly reflect the heterogeneous nature of depression. Depression is characterized by a number of distinct symptoms which can form unique combinations within individuals, and people with depression may thus have different symptom profiles. Previous studies have shown the different symptoms of depression to be differently related to biological and social risk factors and functional impairment.[8] Thus, the symptoms of depression might also be differently related to people's probability of seeking treatment.

The few previous studies comparing associations of different depressive symptoms and health care utilization have reported mixed findings.[9–13] Furthermore, these studies have been based on cross-sectional samples of clinically depressed individuals in young or middle adulthood. The longitudinal associations of depressive symptoms with health care utilization among older adults in the general population are not known. We used data from the longitudinal population-based multi-country Survey of Health, Aging and Retirement in Europe (SHARE) to examine whether some depressive symptoms are particularly relevant in predicting subsequent health care utilization among older adults. We assessed treatment contact in general (contact with a medical doctor (MD)) and psychiatric treatment contact specifically (treatment for depression and inpatient psychiatric admission). Because somatic depressive symptoms – fatigue, sleep problems, appetite change and psychomotor retardation or agitation – have been linked to poor physical health,[14,15] we hypothesized that somatic symptoms would be associated with treatment contact in general. Moreover, we anticipated that cognitive/affective depressive symptoms – diminished interest, sad mood, hopelessness, suicidal ideation and concentration difficulties – would be particularly relevant in determining psychiatric treatment contact specifically.

MATERIALS AND METHODS

Sample

The Survey of Health, Aging and Retirement in Europe (SHARE) is a cross-national panel study that has collected data from up to 140,000 persons from 27 European countries and Israel. To date, SHARE comprises 7 study waves. The SHARE target population consists of all persons aged 50 years and older at the time of sampling who have their regular domicile in the respective SHARE country (persons are excluded if they are incarcerated, hospitalized, or out of the country during the entire survey period, unable to speak the country's languages). The sampling is designed to draw inferences about the population of people aged 50 years and older across countries by using probability-based sampling. In Wave 1, all age-eligible persons per sampled household (plus their partners, regardless of age) were selected for an interview. Since Wave 2, only one age-eligible person per household (plus partner, regardless of age) has been selected. All SHARE respondents who were interviewed in any previous wave (including non-responding partners) are part of the longitudinal sample. Additionally, refreshment samples are drawn regularly to maintain representation of the younger age-cohorts of the target population that were not age-eligible in previous waves, and to compensate for the reduction in panel sample size due to attrition.[16] More details about the sample can be found at http://www.share-project.org/.

In this study, we used all available data on depressive symptoms and health care utilization with respect to three outcomes: 1) any contact with an MD, 2) treatment for depression and 3) inpatient psychiatric admission. These data comprised three follow-ups: from Wave 1 (taking place in 2004-2006) to 2 (2006-2010), 2 to 4 (2010-2012) and 4 to 5 (2013) (**Table 1**).[17–24] A total of 55,750 individuals were initially eligible for this study, as they had data on depressive symptoms and covariate data in at least one follow-up. Different subsamples of these initially eligible participants were used in the analyses for the three outcomes. First, in analyses on the association between depressive symptoms and contact with an MD, 2,846 participants initially eligible were excluded due to missing outcome data in all follow-ups, which left a study population of 52,904. Second, in analyses on the association between depressive symptoms and treatment for depression, 29,813 participants initially eligible were excluded due to missing outcome data in all follow-ups (n=27,066) or prior depression treatment/inpatient psychiatric admission (n=2,747), which left a study population of 25,937. Third, in analyses on the association between depressive symptoms and inpatient psychiatric

admission, 27,496 participants initially eligible were excluded due to missing outcome data in all follow-ups (n=27,067) or prior psychiatric admission (n=429), which left a study population of 28,254. Across the three outcomes, a total of 53,139 participants contributed 79,467 person-observations in the analyses during the follow-up. The number of included individuals with exposure and outcome data in each follow-up is presented in **Table 1**.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects/patients were approved by the Ethics Committee of the University of Mannheim (Waves 1 to 4) and by the Ethics Council of the Max Planck Society (Wave 5). Depending on the country of interview, written or verbal consent was obtained from all participants. Verbal consent was witnessed and formally recorded.

[Table 1]

Health care utilization

Health care utilization was assessed with three separate outcomes: 1) frequency of contact (i.e., number of visits) with an MD during the past 12 months, 2) treatment for depression by a doctor or psychiatrist (ever/never) and 3) inpatient psychiatric admission (ever/never).

Data on the frequency of contact with an MD was self-reported by participants as the number of times they visited or had contact with an MD during the past 12 months (top-coded to 30 visits), without asking the specific reasons for the MD visits. Data on the frequency of contact with an MD was recorded in all three follow-ups (**Table 1**). Data on both treatment for depression (ever/never treated for depression by a doctor or psychiatrist) and on inpatient psychiatric admission (ever/never admitted to a psychiatric hospital or psychiatric ward) were self-reported by participants, and recorded in the two first follow-ups (**Table 1**).

Depressive symptoms

Depressive symptoms were self-reported using the 12-item EURO-D scale.[25,26] EURO-D has been developed to allow comparisons of depression symptom profiles between European countries and has previously been validated in the cross-European EURODEP study.[25,26] EURO-D includes dichotomous items (yes/no) measuring sad/depressed mood, hopelessness,

suicidal ideation, guilt, sleep problems, diminished interest, irritability, changes in appetite, fatigue, concentration problems, lack of enjoyment and tearfulness during the past month. Depressive symptoms were assessed in all three follow-ups (**Table 1**).

Confounders

All analyses were adjusted for sex, age, country of interview, follow-up time, and all depressive symptoms in each follow-up. We additionally adjusted the analyses for educational attainment, presence of a partner in household, body mass index (BMI), the number of chronic diseases, disability and frequency of contact with an MD at the follow-up baseline. Sex and age were self-reported. Country of interview was recorded as part of the data collection. Educational attainment was measured through self-reports according to the International Standard Classification of Education (ISCED-97) on a 7-point scale: pre-primary, primary, lower secondary, (upper) secondary, post-secondary non tertiary, first stage of tertiary (not leading directly to an advanced research qualification) and second stage of tertiary education (leading to an advanced research qualification). The presence of a partner in household (yes/no) was self-reported. BMI (kg/m^2) was assessed using self-reported height and weight, and the number of chronic diseases was measured as a count of self-reported diagnoses (yes/no) of diabetes, high blood pressure, stroke, heart attack, chronic lung disease and cancer. Disability (yes/no) was assessed through self-reported limitations using the Activities of Daily Living scale of 10 items (0 limitations vs $\geq$1 limitation).

Statistical analysis

Associations of depressive symptoms with frequency of contact with an MD were estimated with multilevel, random-intercept negative binomial regression models. The negative binomial regression was used to model the count outcome with overdispersion and the random-intercept multilevel model took into account the non-independence of the repeated person-observations from the same individuals and the average rates of MD visits between individuals. Associations of depressive symptoms with treatment for depression and inpatient psychiatric admission were assessed with multilevel, random-intercept logistic regression models. All analyses were conducted using time-lagged time intervals in the exposure and outcome measurement within each follow-up, so that treatment outcomes measured at the end of each follow-up were regressed on depressive symptoms (and confounders) measured at the follow-up baseline (**Table 1**). All three health care utilization outcomes (contact with an MD, treatment for depression and inpatient psychiatric admission) were analyzed in separate

models. We first assessed the associations in minimally adjusted models controlling for sex, age, country of interview, follow-up time and all other depressive symptoms. Then we further adjusted these models for educational attainment, presence of a partner in household, BMI, the number of chronic diseases and disability. When assessing treatment for depression and inpatient psychiatric admission, these fully adjusted models were also adjusted for the frequency of contact with an MD at the follow-up baseline. In analyses on the frequency of contact with an MD, the average differences in the outcome were already modelled by the random intercept of the multilevel model. Selective attrition was assessed with random-intercept multilevel logistic regression predicting attrition at the end of each follow-up by the EURO-D sum score and individual depressive symptoms at the follow-up baseline. The results of the attrition analyses are presented in **Supplementary Tables 1–2**. All analyses were conducted in Stata 16.0 (StataCorp, College Station, TX, USA).

RESULTS

Supplementary Table 3 presents the characteristics of 53,139 SHARE participants. Across all follow-ups, there were 30,227 (57%) women. The mean age was 64.5 (SD, 10.0). Mean frequency of contact with an MD (during past 12 months within each follow-up) was 6.5 (SD, 6.8). A total of 2,433 (5%) participants received treatment for depression and 286 (<1%) were admitted to inpatient psychiatric treatment. Correlations between depressive symptoms were from weak to moderate (Pearson's r=0.05–0.39, **Supplementary Table 4**).

Figure 1 presents the incidence rate ratios (IRR) from multilevel negative binomial regression models for the association between depressive symptoms and frequency of contact with an MD during the past 12 months. When adjusting for age, sex, country of interview and follow-up time, prior fatigue (IRR=1.15) and sleep problems (IRR=1.13) were most strongly associated with more frequent contact with an MD. Also, prior sad/depressed mood, tearfulness, concentration problems, guilt, irritability, changes in appetite and suicidal ideation were associated with higher frequency of contact with an MD (IRR=1.02-1.06) (**Figure 1**). These associations except for suicidal ideation (p=0.544) remained after additional adjustment for educational attainment, presence of a partner in household, BMI, the number of chronic diseases and disability (**Figure 1, Supplementary Table 5**). In the fully adjusted model, lack of enjoyment was associated with less frequent contact with an MD (IRR=0.98).

[Figure 1]

In multilevel logistic regression analyses adjusted for age, sex, country of interview and follow-up time, treatment for depression was most strongly associated with prior sad/depressed mood (OR=2.22) and suicidal ideation (OR=1.83) (**Figure 2**). Treatment for depression was also associated with prior sleep problems, changes in appetite, fatigue, concentration problems, hopelessness and irritability (OR=1.20-1.57) (**Figure 2**). Additional adjustment for educational attainment, presence of a partner in household, BMI, the number of chronic diseases, disability and frequency of contact with an MD at the follow-up baseline did not attenuate any of these associations (**Figure 2, Supplementary Table 6**).

[Figure 2]

In analyses on inpatient psychiatric admission, the estimates were less precise due to the small number of cases admitted to inpatient treatment. Prior sad/depressed mood was most strongly associated with psychiatric inpatient admission (OR=2.77) (**Figure 3**). In addition, prior appetite change, fatigue, suicidal ideation, lack of enjoyment and sleep problems were more common among those admitted to inpatient psychiatric care (OR=1.52-1.77) (**Figure 3**). After additional adjustment for educational attainment, presence of a partner in household, BMI, the number of chronic diseases, disability and frequency of contact with an MD at the follow-up baseline, most associations remained. However, the associations of suicidal ideation and lack of enjoyment with inpatient admission were no longer statistically significant (p=0.096 and p=0.066) (**Figure 3, Supplementary Table 7**).

[Figure 3]

DISCUSSION

In this longitudinal study among 53,139 aging people across Europe, depressive symptoms were differently related to health care utilization. People with more frequent contact with an MD had most often reported sleep problems and fatigue, followed by sad/depressed mood, tearfulness, concentration problems, guilt, irritability and changes in appetite in the previous study wave. By contrast, those treated for depression had most often reported sad/depressed mood and suicidal ideation, but also sleep problems, changes in appetite, fatigue, concentration problems, hopelessness and irritability. Sad/depressed mood was also

associated with subsequent admission to psychiatric inpatient care. Similarly to the other health care outcomes, appetite change, fatigue and sleep problems were more common among those admitted to psychiatric inpatient care.

Previous studies among younger people with clinical depression have reported inconclusive findings.[9–13] Most often, treatment utilization has been linked to suicidal ideation or behavior,[10,12] sleep problems,[9,10,12] fatigue,[9,12,13] and difficulty to concentrate.[10,12,13] We found evidence to support these associations, but also provide a more detailed picture of the symptom-specific associations in population-based data from SHARE.

In our study, most depressive symptoms included in the EURO-D were associated both with visiting an MD and being treated for depression, suggesting they independently contribute to health care utilization. Although the same symptoms were associated with both these outcomes, there were differences in the relative magnitude of the associations. Two somatic symptoms – fatigue and sleep problems – were most strongly associated with higher frequency of contact with an MD. Previous literature has linked somatic depressive symptoms – sleep problems, fatigue, appetite change and psychomotor retardation or agitation – to poor physical health,[14,15] and this association of somatic symptoms with greater health concern may be reflected as a higher frequency of contact with an MD, especially in older populations.[2] Depressive symptoms, especially somatic symptoms, may also be characteristic physical conditions other than depression. Although we expected the associations between depressive symptoms and contact with an MD to attenuate after adjusting for chronic diseases and BMI, the associations were robust against confounding by these factors, suggesting the depressive symptoms contribute to health care utilization regardless of comorbid physical conditions. This is in line with previous studies suggesting that the age-associated declines in physical health do not explain all the increase in depressive symptoms among elderly people.[1,27,28]

By contrast, two cognitive/affective symptoms of depression, sad/depressed mood and suicidal ideation were most strongly associated with higher likelihood of being treated for depression. Explanations for these associations likely involve the central role of these two symptoms in depression treatment context. Sad/depressed mood is a key symptom of depression which, together with anhedonia, is a core criterion for a depression diagnosis in the current diagnostic systems (both ICD and DSM-V),[29,30] and it has been shown to play a

major role in diagnostic clinical decision-making.[31] Suicidal ideation in turn, is an acute depressive symptom that clinicians tend to use when assessing depression severity.[32] Suicidal ideation often requires immediate clinical attention and thus likely influences decisions over treatment and its course.[33,34]

Sad/depressed mood was also associated with psychiatric inpatient treatment, together with somatic symptoms of fatigue, sleep problems and changes in appetite. However, these results were statistically imprecise and need to be interpreted with caution due to the low number of cases receiving psychiatric inpatient care in our analytic sample. Psychiatric inpatient treatment in the general population is rare,[35] and often involves prior treatment contact.[36,37] Inpatient admission may result from a qualitative clinical assessment based on factors such as symptom severity or level of functional impairment rather than the presence of specific symptoms,[36,37] and thus our data were not ideal for a detailed assessment of the determinants of hospitalization. Nevertheless, our results point to the relevance of sad/depressed mood to both outpatient and inpatient psychiatric treatment for depression, together with the cluster of somatic symptoms.

We found no consistent evidence for associations of diminished interest and lack of enjoyment with health care utilization, although anhedonia in particular is often considered to be crucial in clinical depression.[29,30] Depressive symptoms are associated with each other but the causal dynamics underlying these associations are not well understood. As we had no hypothesis about the underlying causal structure, we adjusted for all depressive symptoms in all models. The null findings may therefore reflect either a lack of true association due to proper control for confounding or overadjustment,[38] the latter being a risk especially given that the associations between different depressive symptoms are likely bidirectional. However, it is also possible that interest loss and lack of enjoyment have naturally inconsistent associations with help-seeking behaviors. Although these symptoms have been associated with disability,[39,40] thus providing incentive to seek treatment, motivational problems, feelings of detachment or apathy likely contained in these symptoms could counteract such incentive. The relevance of symptom-specific impairment to health care utilization, as well as the underlying mechanisms explaining the symptom-specific associations need to be explored further. However, it bears emphasis that none of the symptoms were consistently associated with *lower* probability of seeking treatment.

Some limitations should be noted. The data were from a longitudinal cohort study where loss to follow-up is inevitable. People experiencing depressive symptoms at follow-up baseline were more often lost to follow-up (**Supplementary Tables 1–2**), and selective attrition could have biased the observed associations. Like any observational study, we cannot rule out the possibility of residual or unmeasured confounding and our design does not allow for causal inference. Apart from the potential risk of overadjustment, we controlled for a set of relevant confounders associated with the depressive symptoms and health care outcomes. Although EURO-D is a validated measure of depression in the European population[25,26] and the EURO-D items have strong conceptual validity, self-reported measures of depressive symptoms involve the risk of reporting bias, and dichotomous items did not allow analyses incorporating symptom severity. Moreover, single-item measures of depressive symptoms may not perfectly discriminate individual depressive symptoms. However, correlations between depressive symptoms were weak, suggesting that there was no substantial overlap between the symptoms. The questionnaire item assessing treatment for depression was limited to treatment provided by a doctor/psychiatrist and thus may not have captured treatment provided by other mental health professionals. Finally, the participants were a rather old population-based cohort residing in Europe, which limits the generalizability of our findings.

In conclusion, we observed differential associations of depressive symptoms with health care utilization among older adults in Europe. Elderly patients at different levels of the health care system may experience different depressive symptoms. The symptom-level approach can elucidate how readily a patient with a specific symptom profile will enter the health care system and what symptom combinations mostly occur at different levels of health care. Such symptom-level differences can contribute to understanding about inequalities of health care utilization and inform clinicians identifying and targeting elderly patients with depression. An important task for further research is to replicate these findings in other populations, elucidate the underlying mechanisms and evaluate the efficiency of received treatment among individuals with different symptom profiles.

This manuscript contains original unpublished work and it is not being submitted for publication elsewhere at the same time.

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Author contributions: All authors contributed to the study conception and design. Kaisla Komulainen performed the statistical analysis and all authors contributed to the interpretation of the data. Kaisla Komulainen drafted the first version of the manuscript and all authors critically revised it for important intellectual content. All authors approved the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of interest: None.

Data availability

The data that support the findings of this study are openly available in SHARE Research Data Center at https://doi.org/10.6103/SHARE.w1.700 (Wave 1), https://doi.org/10.6103/SHARE.w2.700 (Wave 2), https://doi.org/10.6103/SHARE.w4.700 (Wave 4), https://doi.org/10.6103/SHARE.w5.700 (Wave 5).

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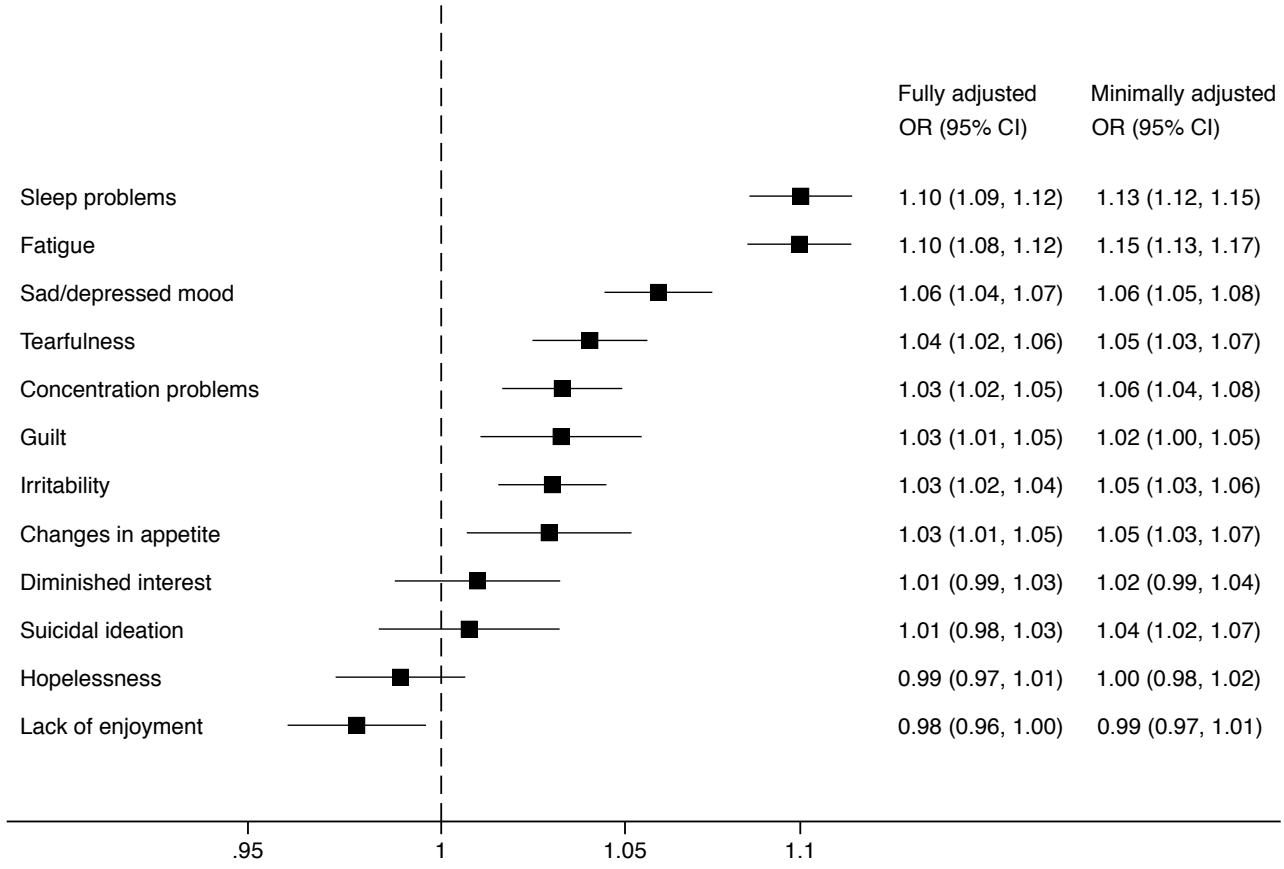
Table 1. The number of SHARE participants contributing data on depressive symptoms and treatment outcomes in each follow-up cycle

	Follow-up from wave 1 to 2	**Follow-up from wave 2 to 4**	**Follow-up from wave 4 to 5**
Wave1	Depressive symptoms n=22778		
Wave 2	Contact with an MD n=21532 Depression treatment n=21240 Inpatient admission n=21240	Depressive symptoms n=22313	
Wave 4		Contact with an MD n=20810 Depression treatment n=18014 Inpatient admission n=18013	Depressive symptoms n=38441
Wave 5			Contact with an MD n=36819

Across all follow-ups, N=79,467 person-observations from 53,139 persons across 3 study waves.

Figure legends

Figure 1. Adjusted incidence rate ratios for the associations of depressive symptoms with frequency of contact with a medical doctor during the past 12 months among SHARE participants

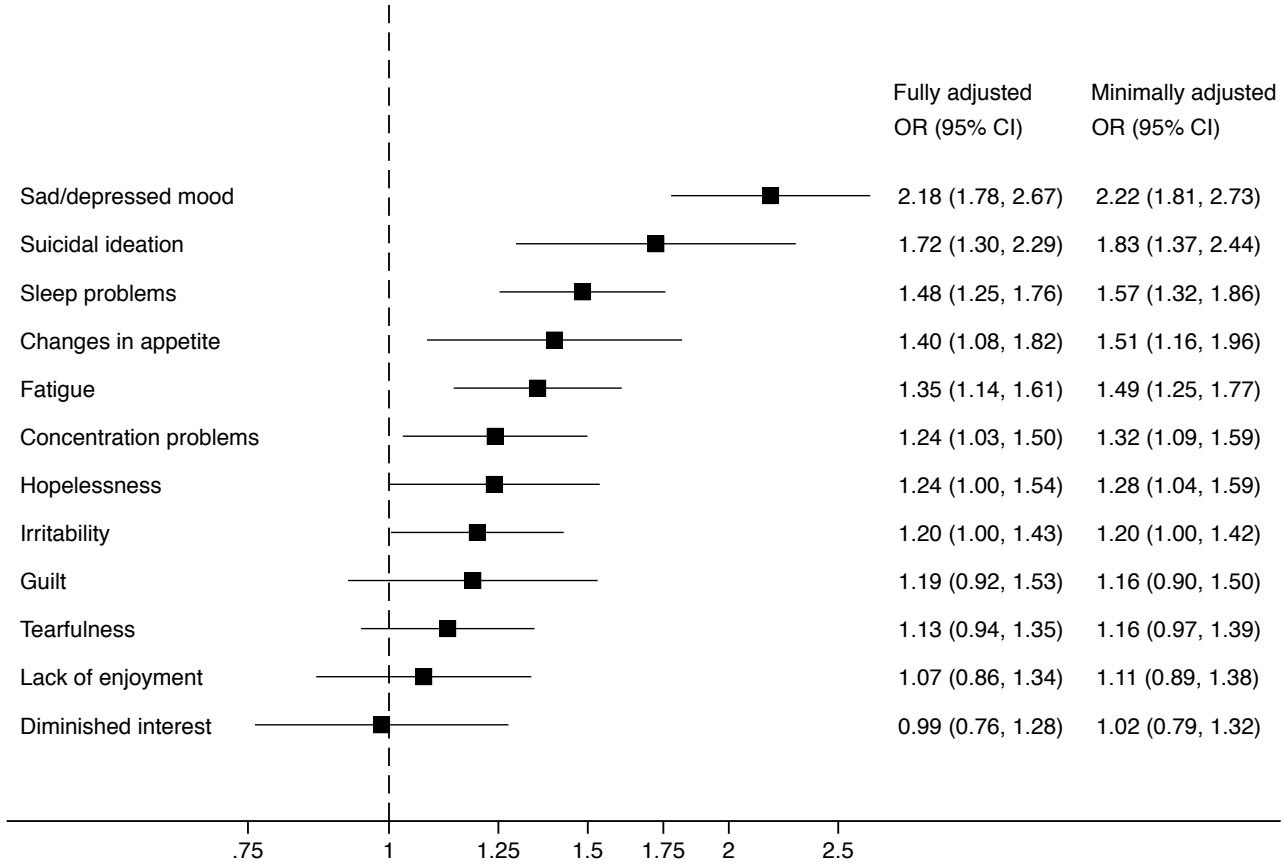


Abbreviations: IRR, incidence rate ratio; CI, confidence interval

All estimates are from multilevel negative binomial regression models with random intercepts. N=79,161 person-observations from 52,904 persons across 3 study waves.

Minimally adjusted model adjusted for sex, age, country of interview, follow-up time and all other depressive symptoms. Fully adjusted model adjusted for sex, age, country of interview, follow-up time, educational attainment, presence of a partner in household, BMI, the number of chronic diseases and disability. Plotted estimates are from the fully adjusted model.

Figure 2. Adjusted odds ratios for the associations of prior depressive symptoms with ever being treated for depression by a doctor or psychiatrist among SHARE participants



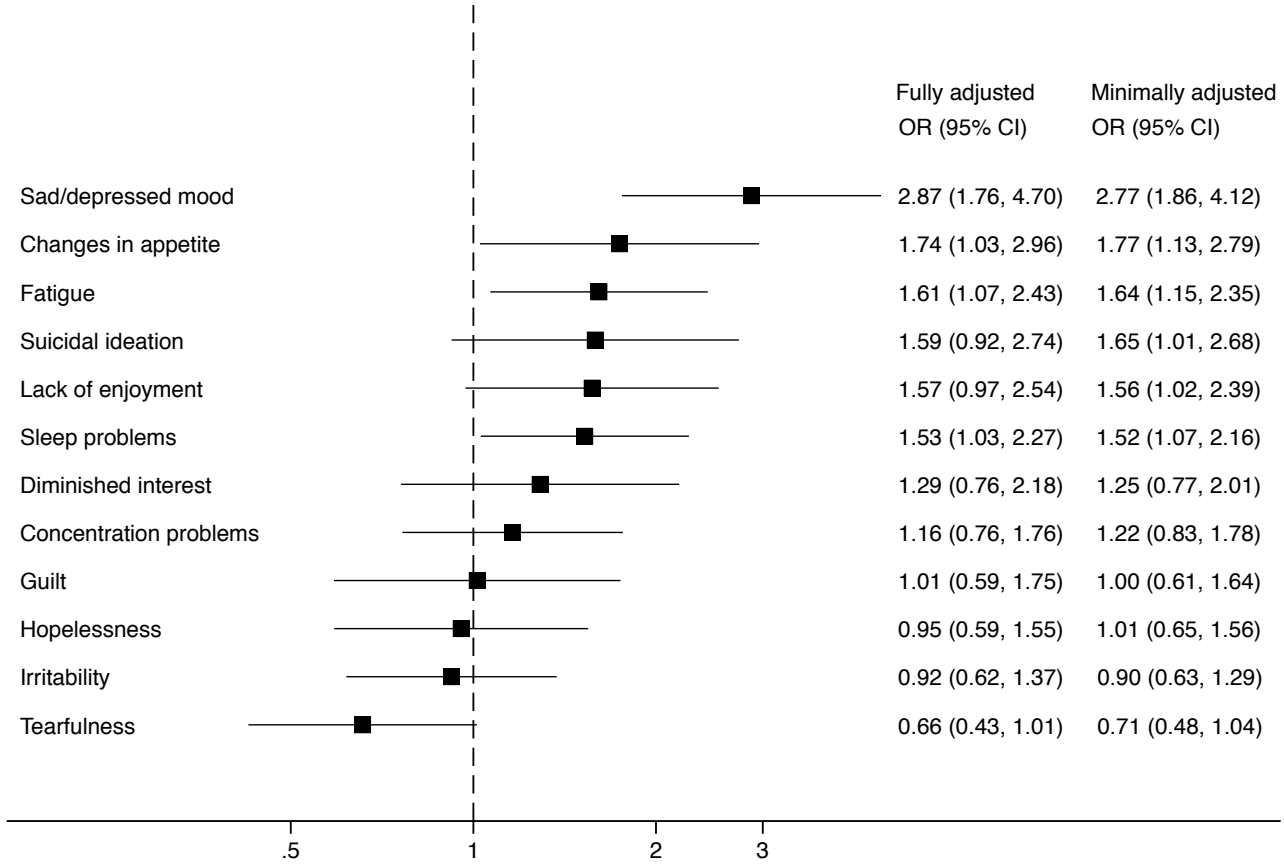
Abbreviations: OR, odds ratio; CI, confidence interval

All estimates are from multilevel logistic regression models with random intercepts.

N=34,381 person-observations from 25,937 persons across 2 study waves.

Minimally adjusted model adjusted for sex, age, country of interview, follow-up time and all other depressive symptoms. Fully adjusted model adjusted for sex, age, country of interview, follow-up time, educational attainment, presence of a partner in household, BMI, the number of chronic diseases, disability and frequency of contact with an MD at follow-up baseline. Plotted estimates are from the fully adjusted model.

Figure 3. Adjusted odds ratios for the association of prior depressive symptoms with ever being admitted to a psychiatric hospital/ward among SHARE participants



Abbreviations: OR, odds ratio; CI, confidence interval

All estimates are from multilevel logistic regression models with random intercepts.

N=38,539 person-observations from 28,254 persons across 2 study waves.

Minimally adjusted model adjusted for sex, age, country of interview, follow-up time and all other depressive symptoms. Fully adjusted model adjusted for sex, age, country of interview, follow-up time, educational attainment, presence of a partner in household, BMI, the number of chronic diseases, disability and frequency of contact with an MD at follow-up baseline. Plotted estimates are from the fully adjusted model.

Supplementary Materials

Supplementary Table 1. Adjusted odds ratios for the associations of EURO-D sum score and covariates at each follow-up baseline with attrition at the end of the follow-up

Supplementary Table 2. Adjusted odds ratios for the associations of depressive symptoms and covariates at each follow-up baseline with attrition at the end of the follow-up

Supplementary Table 3. Characteristics of 53,139 participants from the Survey of Health, Aging and Retirement in Europe

Supplementary Table 4. Correlations between depressive symptoms among SHARE participants

Supplementary Table 5. Adjusted incidence rate ratios for the associations of depressive symptoms and covariates with frequency of contact with a medical doctor during the past 12 months among SHARE participants

Supplementary Table 6. Adjusted odds ratios for the associations of prior depressive symptoms and covariates with ever being treated for depression by a doctor or psychiatrist among SHARE participants

Supplementary Table 7. Adjusted odds ratios for the association of prior depressive symptoms and covariates with ever being admitted to a psychiatric hospital/ward among SHARE participants

Association of depressive symptoms with health care utilization in older adults: Longitudinal evidence from the Survey of Health, Aging and Retirement in Europe

Supplementary Material

Supplementary Table 1. Adjusted odds ratios for the associations of EURO-D sum score and covariates at each follow-up baseline with attrition at the end of the follow-up

	OR	2.50%	97.50%	p-value
Sex (female)	0.51	0.46	0.58	0.000
Age	1.14	1.13	1.16	0.000
Country				
Austria	1.00	.	.	.
Germany	0.63	0.45	0.88	0.007
Sweden	1.65	1.24	2.19	0.001
Netherlands	1.19	0.88	1.59	0.257
Spain	2.23	1.70	2.93	0.000
Italy	0.68	0.51	0.90	0.008
France	0.72	0.55	0.95	0.019
Denmark	1.49	1.10	2.02	0.009
Greece	0.24	0.15	0.38	0.000
Switzerland	0.65	0.47	0.90	0.010
Belgium	0.60	0.46	0.79	0.000
Israel	10.29	7.40	14.32	0.000
Czech Republic	1.75	1.32	2.30	0.000
Poland	0.78	0.53	1.15	0.211
Slovenia	0.36	0.23	0.56	0.000
Estonia	1.03	0.78	1.35	0.854
Follow-up time	1.41	1.36	1.46	0.000
EURO-D sum score	1.26	1.23	1.29	0.000

Abbreviations: OR, odds ratio

All estimates are from mutually adjusted models.

A total of 1507 (7%) participants were lost to follow-up between Waves 1–2, 2129 (9%) between Waves 2–4 and 2577 (7%) participants between Waves 4–5.

Supplementary Table 2. Adjusted odds ratios for the associations of depressive symptoms and covariates at each follow-up baseline with attrition at the end of the follow-up

	OR	2.50%	97.50%	p-value
Sex (female)	0.55	0.49	0.62	0.000
Age	1.13	1.12	1.14	0.000
Country				
Austria	1.00	.	.	.
Germany	0.68	0.48	0.95	0.022
Sweden	1.70	1.28	2.26	0.000
Netherlands	1.23	0.92	1.64	0.169
Spain	2.07	1.59	2.70	0.000
Italy	0.69	0.52	0.92	0.012
France	0.77	0.59	1.01	0.058
Denmark	1.55	1.15	2.10	0.004
Greece	0.25	0.16	0.39	0.000
Switzerland	0.72	0.52	0.99	0.044
Belgium	0.63	0.48	0.82	0.001
Israel	10.36	7.61	14.11	0.000
Czech Republic	1.79	1.36	2.36	0.000
Poland	0.80	0.54	1.17	0.243
Slovenia	0.37	0.24	0.58	0.000
Estonia	1.14	0.87	1.50	0.340
Follow-up time	1.41	1.36	1.46	0.000
Sad/depressed mood	0.98	0.88	1.10	0.724
Hopelessness	1.45	1.28	1.64	0.000
Suicidal ideation	1.47	1.24	1.74	0.000
Guilt	0.64	0.54	0.77	0.000
Sleep problems	1.06	0.95	1.18	0.284
Diminished interest	1.56	1.34	1.82	0.000
Irritability	0.90	0.80	1.00	0.058
Changes in appetite	2.13	1.83	2.47	0.000
Fatigue	1.55	1.39	1.72	0.000
Concentration problems	1.49	1.32	1.67	0.000
Lack of enjoyment	1.46	1.29	1.67	0.000
Tearfulness	1.07	0.95	1.21	0.256

Abbreviations: OR, odds ratio

All estimates are from mutually adjusted models.

A total of 1507 (7%) participants were lost to follow-up between Waves 1–2, 2129 (9%) between Waves 2–4 and 2577 (7%) participants between Waves 4–5.

Supplementary Table 3. Characteristics of 53,139 participants from the Survey of Health, Aging and Retirement in Europe

	Follow-up from wave 1 to 2			Follow-up from wave 2 to 4			Follow-up from wave 4 to 5		
	Mean (SD)	n [%]	N	Mean (SD)	n [%]	N	Mean (SD)	n [%]	N
Age	63.7 (10.3)		22778	64.4 (9.9)		22313	65.6 (10.1)		38441
Sex (women)		12722 [56%]	22778		12480 [56%]	22313		21943 [57%]	38441
Country			22778			22313			38441
Austria		1255 [6%]			839 [4%]			3956 [10%]	
Germany		1778 [8%]			1487 [7%]			1062 [3%]	
Sweden		2386 [10%]			2000 [9%]			1455 [4%]	
Netherlands		1998 [9%]			1746 [8%]			2174 [6%]	
Spain		1768 [8%]			1775 [8%]			2902 [8%]	
Italy		1929 [8%]			2272 [10%]			2622 [7%]	
France		2286 [10%]			2067 [9%]			3884 [10%]	
Denmark		1402 [6%]			2004 [9%]			1958 [5%]	
Greece		2388 [10%]							
Switzerland		730 [3%]			1080 [5%]			2933 [8%]	
Belgium		2973 [13%]			2406 [11%]			3935 [10%]	
Israel		1885 [8%]			1594 [7%]				
Czech Republic					1433 [6%]			4045 [11%]	
Poland					1610 [7%]				
Slovenia								1947 [5%]	
Estonia								5568 [14%]	
Follow-up time (years)	3.0 (1.5)		22778	4.4 (0.8)		22313	2.0 (0.2)		38441
Educational attainment (ISCED-97)			22778			22313			38441
None		1248 [5%]			841 [4%]			1079 [3%]	
1		6482 [28%]			5625 [25%]			6813 [18%]	
2		3933 [17%]			3833 [17%]			7529 [20%]	
3		6114 [27%]			6622 [30%]			12976 [34%]	
4		606 [3%]			814 [4%]			1858 [5%]	
5		4295 [19%]			4477 [20%]			7860 [20%]	
6		100 [0.4%]			101 (0.5%]			326 [1%]	
Presence of a partner in household		16992 [75%]	22778		16958 [76%]	22313		27551 [72%]	38441

Number of chronic diseases	0.7 (0.9)		22778	0.8 (0.9)		22313	0.9 (0.9)	38441
Body mass index (kg/m^2)	26.0 (5.5)		22778	26.1 (5.7)		22313	26.1 (6.6)	38441
Disability		2099 [9%]	22778		2058 [9%]	22313	4149 [11%]	38441
Depressive symptoms			22778			22313		38441
Sad/depressed mood		8757 [38%]			8410 [38%]		15702 [41%]	
Hopelessness		3178 [14%]			3299 [15%]		6928 [18%]	
Suicidal ideation		1597 [7%]			1454 [7%]		2860 [7%]	
Guilt		1900 [8%]			1758 [8%]		3412 [9%]	
Sleep problems		7102 [31%]			7457 [33%]		13585 [35%]	
Diminished interest		2046 [9%]			1902 [9%]		3253 [8%]	
Irritability		5595 [25%]			5748 [26%]		11215 [29%]	
Changes in appetite		1841 [8%]			1807 [8%]		3196 [8%]	
Fatigue		7301 [32%]			7435 [33%]		14133 [37%]	
Concentration problems		4725 [21%]			4182 [19%]		6806 [18%]	
Lack of enjoyment		3061 [13%]			2812 [13%]		4851 [13%]	
Crying		6220 [27%]			5638 [25%]		9432 [25%]	
Frequency of contact with an MD[a,b]	6.4 (6.9)		21532	6.7 (6.8)		20810	6.5 (6.8)	36819
Treated for depression[b,c]		1446 [7%]	21240		1303 [7%]	18014		
Inpatient admission[c,d]		137 [0.7%]	21240		173 [1%]	18013		

Across all follow-ups, N=79,467 person-observations from 53,139 persons across 3 study waves

Not all percentages add up to 100% due to rounding.

All values are calculated at the follow-up baseline unless otherwise noted.

[a] During past 12 months

[b] Ever treated for depression by a doctor/psychiatrist

[c] At the end of each follow-up (i.e. in the later study wave)

[d] Ever admitted to a psychiatric hospital/ward

Supplementary Table 4. Correlations between depressive symptoms among SHARE participants

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Sad/depressed mood												
2. Hopelessness	0.13											
3. Suicidal ideation	0.25	0.19										
4. Guilt	0.20	0.06	0.18									
5. Sleep problems	0.30	0.11	0.17	0.13								
6. Diminished interest	0.18	0.17	0.22	0.12	0.17							
7. Irritability	0.30	0.08	0.16	0.15	0.21	0.14						
8. Changes in appetite	0.17	0.12	0.18	0.09	0.17	0.21	0.13					
9. Fatigue	0.31	0.13	0.20	0.14	0.25	0.20	0.24	0.20				
10. Concentration problems	0.15	0.13	0.16	0.09	0.15	0.21	0.12	0.15	0.20			
11. Lack of enjoyment	0.08	0.20	0.12	0.05	0.08	0.18	0.07	0.12	0.11	0.15		
12. Tearfulness	0.39	0.06	0.21	0.14	0.21	0.15	0.20	0.16	0.20	0.14	0.07	

All correlations are statistically significant ($p<0.001$).
Depressive symptoms measured at the first wave available for each participant (n=53,139).

Supplementary Table 5. Adjusted incidence rate ratios for the associations of depressive symptoms and covariates with frequency of contact with a medical doctor during the past 12 months among SHARE participants

	IRR	2.50%	97.50%	z-score	p-value
Sex (female)	1.09	1.08	1.11	12.05	0.000
Age	1.01	1.01	1.01	30.10	0.000
Country					
Austria	1.00	.	.	.	.
Germany	1.14	1.09	1.18	6.67	0.000
Sweden	0.54	0.52	0.56	-32.00	0.000
Netherlands	0.75	0.73	0.78	-15.25	0.000
Spain	0.99	0.95	1.02	-0.70	0.483
Italy	1.07	1.03	1.11	3.89	0.000
France	1.08	1.04	1.11	4.69	0.000
Denmark	0.73	0.70	0.76	-16.37	0.000
Greece	0.79	0.75	0.82	-10.34	0.000
Switzerland	0.77	0.75	0.80	-13.48	0.000
Belgium	1.19	1.15	1.22	10.96	0.000
Israel	1.04	0.99	1.08	1.69	0.092
Czech Republic	1.08	1.05	1.12	4.63	0.000
Poland	0.94	0.89	0.99	-2.50	0.012
Slovenia	0.75	0.72	0.79	-11.73	0.000
Estonia	0.69	0.67	0.72	-20.65	0.000
Follow-up time	1.02	1.02	1.03	9.84	0.000
Educational attainment	1.00	1.00	1.01	0.43	0.669
Partner in household	1.03	1.01	1.05	3.58	0.000
BMI	1.01	1.01	1.01	12.72	0.000
Number of chronic diseases	1.24	1.24	1.25	60.03	0.000
Disability	1.13	1.10	1.15	11.29	0.000
Sad/depressed mood	1.06	1.04	1.07	7.90	0.000
Hopelessness	0.99	0.97	1.01	-1.23	0.218
Suicidal ideation	1.01	0.98	1.03	0.61	0.544
Guilt	1.03	1.01	1.05	2.91	0.004
Sleep problems	1.10	1.09	1.12	13.72	0.000
Diminished interest	1.01	0.99	1.03	0.86	0.390
Irritability	1.03	1.02	1.04	4.03	0.000
Changes in appetite	1.03	1.01	1.05	2.57	0.010
Fatigue	1.10	1.08	1.12	13.51	0.000
Concentration problems	1.03	1.02	1.05	3.95	0.000
Lack of enjoyment	0.98	0.96	1.00	-2.39	0.017
Tearfulness	1.04	1.02	1.06	5.07	0.000

N=79,161 person-observations from 52,904 persons across 3 study waves
Abbreviations: IRR, incidence rate ratio; body mass index
All estimates are from mutually adjusted models.
All covariates measured at each follow-up baseline.

Supplementary Table 6. Adjusted odds ratios for the associations of prior depressive symptoms and covariates with ever being treated for depression by a doctor or psychiatrist among SHARE participants

	OR	2.50%	97.50%	z-score	p-value
Sex (female)	1.98	1.61	2.43	6.44	0.000
Age	0.98	0.97	0.99	-4.94	0.000
Country					
Austria	1	.	.	.	.
Germany	0.88	0.57	1.38	-0.54	0.589
Sweden	0.87	0.55	1.35	-0.63	0.529
Netherlands	0.81	0.52	1.28	-0.90	0.366
Spain	2.05	1.32	3.19	3.19	0.001
Italy	0.88	0.57	1.35	-0.60	0.549
France	0.96	0.62	1.47	-0.21	0.835
Denmark	1.21	0.77	1.89	0.83	0.405
Greece	0.14	0.07	0.30	-5.23	0.000
Switzerland	0.78	0.46	1.32	-0.93	0.351
Belgium	1.34	0.89	2.03	1.40	0.161
Israel	1.30	0.82	2.06	1.10	0.270
Czech Republic	1.51	0.92	2.47	1.64	0.101
Poland	0.26	0.14	0.48	-4.28	0.000
Follow-up time	1.27	1.16	1.38	5.29	0.000
Educational attainment	0.98	0.92	1.04	-0.75	0.454
Partner in household	0.92	0.77	1.11	-0.84	0.402
BMI	0.99	0.98	1.01	-1.15	0.248
Number of chronic diseases	1.09	1.00	1.20	1.87	0.061
Disability	1.44	1.12	1.85	2.83	0.005
Frequency of prior contact with an MD	1.03	1.02	1.04	4.50	0.000
Sad/depressed mood	2.18	1.78	2.67	7.51	0.000
Hopelessness	1.24	1.00	1.54	1.96	0.050
Suicidal ideation	1.72	1.30	2.29	3.74	0.000
Guilt	1.19	0.92	1.53	1.32	0.188
Sleep problems	1.48	1.25	1.76	4.57	0.000
Diminished interest	0.99	0.76	1.28	-0.11	0.910
Irritability	1.20	1.00	1.43	2.00	0.045
Changes in appetite	1.40	1.08	1.82	2.54	0.011
Fatigue	1.35	1.14	1.61	3.47	0.001
Concentration problems	1.24	1.03	1.50	2.25	0.024
Lack of enjoyment	1.07	0.86	1.34	0.63	0.526
Tearfulness	1.13	0.94	1.35	1.33	0.184

N=34,381 person-observations from 25,937 persons across 2 study waves
Abbreviations: OR, odds ratio; BMI, body mass index; MD, medical doctor
All estimates are from mutually adjusted models.
All covariates measured at each follow-up baseline.

Supplementary Table 7. Adjusted odds ratios for the association of prior depressive symptoms and covariates with ever being admitted to a psychiatric hospital/ward among SHARE participants

	OR	2.50%	97.50%	z-score	p-value
Sex (female)	0.86	0.58	1.26	-0.79	0.431
Age	0.96	0.93	0.98	-3.84	0.000
Country					
Austria	1	.	.	.	.
Germany	1.99	0.63	6.31	1.17	0.244
Sweden	1.24	0.38	4.12	0.36	0.720
Netherlands	0.86	0.24	3.01	-0.24	0.810
Spain	1.44	0.46	4.56	0.63	0.531
Italy and Greece	0.75	0.24	2.39	-0.48	0.629
France	1.58	0.52	4.83	0.81	0.420
Denmark	1.31	0.39	4.43	0.43	0.667
Switzerland	1.74	0.48	6.27	0.85	0.395
Belgium	2.31	0.76	6.97	1.48	0.138
Israel	0.92	0.24	3.44	-0.13	0.898
Czech Republic	5.75	1.71	19.26	2.83	0.005
Poland	0.66	0.18	2.45	-0.62	0.536
Follow-up time	1.44	1.20	1.72	3.93	0.000
Educational attainment	0.88	0.76	1.02	-1.71	0.088
Partner in household	0.65	0.43	0.99	-2.01	0.044
BMI	0.98	0.96	1.01	-1.17	0.244
Number of chronic diseases	1.01	0.82	1.26	0.13	0.897
Disability	0.90	0.51	1.59	-0.36	0.717
Frequency of contact with an MD	1.03	1.00	1.05	1.94	0.053
Sad/depressed mood	2.87	1.76	4.70	4.20	0.000
Hopelessness	0.95	0.59	1.55	-0.19	0.851
Suicidal ideation	1.59	0.92	2.74	1.66	0.096
Guilt	1.01	0.59	1.75	0.05	0.958
Sleep problems	1.53	1.03	2.27	2.10	0.036
Diminished interest	1.29	0.76	2.18	0.94	0.347
Irritability	0.92	0.62	1.37	-0.41	0.684
Changes in appetite	1.74	1.03	2.96	2.05	0.040
Fatigue	1.61	1.07	2.43	2.26	0.024
Concentration problems	1.16	0.76	1.76	0.70	0.485
Lack of enjoyment	1.57	0.97	2.54	1.84	0.066
Tearfulness	0.66	0.43	1.01	-1.90	0.057

N=38,539 person-observations from 28,254 persons across 2 study waves
Abbreviations: OR, odds ratio; BMI, body mass index; MD, medical doctor
All estimates are from mutually adjusted models.
All covariates measured at each follow-up baseline.